Pressure Infiltration Casting Laboratory

Purpose:

To advance metal matrix composite (MMC) technology through in-house alloy development and manufacturing demonstration of MMC hardware.

The pressure infiltration casting facility is for the advancement of MMC technology. MMCs are materials of interest because of their advantages over conventional materials, including high specific strength and stiffness, compatibility with hydrogen and oxygen, low thermal expansion, higher electrical and thermal conductivity than polymer matrix composites and affordability due to the manufacturing of complex parts by low cost casting process.

Metal matrix composites are reinforced metals. The reinforcements are generally ceramics in forms of fibers, particulates, fabric, wires and whiskers. Common metallic alloys include magnesium, aluminum, copper, titanium, iron, nickel and others.

Currently, at MSFC there are several efforts that are exploring the applicability of new MMC materials. These efforts include propulsion engine hardware structural jackets for combustion chambers, injector bodies, valves, flanges, turbopump housings, ducts and lines. There are several other commercial and DoD applications in service.

The MSFC pressure infiltration casting process involves these steps for particulate MMCs:

- Start with a CAD file to 3 dimensionally print a ceramic preform layer by layer
- Dry and sinter the preform to give it strength
- Machine the mold
- Fit the preform in the mold
- Heat the mold, including the alloy charge in the pressure chamber/furnace
- Apply gas pressure to infiltrate the ceramic preform with metal to obtain the MMC.

For fiber reinforced MMCs the process will differ at the preform manufacturing stage. The pressure infiltration casting still remains the same.

The casting chamber at MSFC is 7” diameter and 36” long. Although the chamber has been primarily designed to make aluminum MMCs, it is possible to use it for copper MMCs also. The general pressures used for pressure infiltration are 900-1200 psi.

Point-of-Contact:

Sandeep Shah / ED33
(256) 544-0836
sandeep.shah@msfc.nasa.gov